Surgical Phase Detection Using Deep Learning
Proposal & Plan

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1 Stated topic and goal

Surgical phase recognition plays a crucial role in the era of digitized surgery. Deep learning solutions have seen great success in endoscopic surgeries. Currently, no prior work has investigated its application in skull-base surgery (Cortical Mastoidectomy). This project will benchmark existing DL solutions and create an innovative DL segmentation algorithm in skull-based surgery.

2 Team members, mentor

- **Students**:
  Xucheng Ma, Xiaorui Zhang, Wenkai Luo
- **Mentors**:
  Max Li, Danielle Trakimas, Dr.Francis Creighton, Prof. Mathias Unberath, Prof. Russ Taylor

3 Relevance/importance

Surgical phase recognition has numerous potential medical applications. Such as automatic indexing of surgical video databases, and optimization of real-time operating room scheduling. It's also a foundation of intelligent context-aware system, which facilitates surgery monitoring, surgical protocol extraction, and decision support.

4 Short technical summary of approach

Kevin

5 Deliverables

Project deliverables are listed as follows:

- **Minimum Deliverables**
  - New dataset from cortical mastoidectomy videos (with Danielle's help)
  - At least 3 methods
  - All methods trained and evaluated on new dataset

- **Expected Deliverables**
  - Experiments and comparison with existing methods
  - Ablation study
- **Maximum Deliverables**
  - Conference paper

6 Timeline & Milestones

Figure 1 shows the project timeline. Milestones are labeled in blue, and deadlines for resolving dependencies are labeled in red. Other entries in the timeline indicate either start point or end point of tasks.

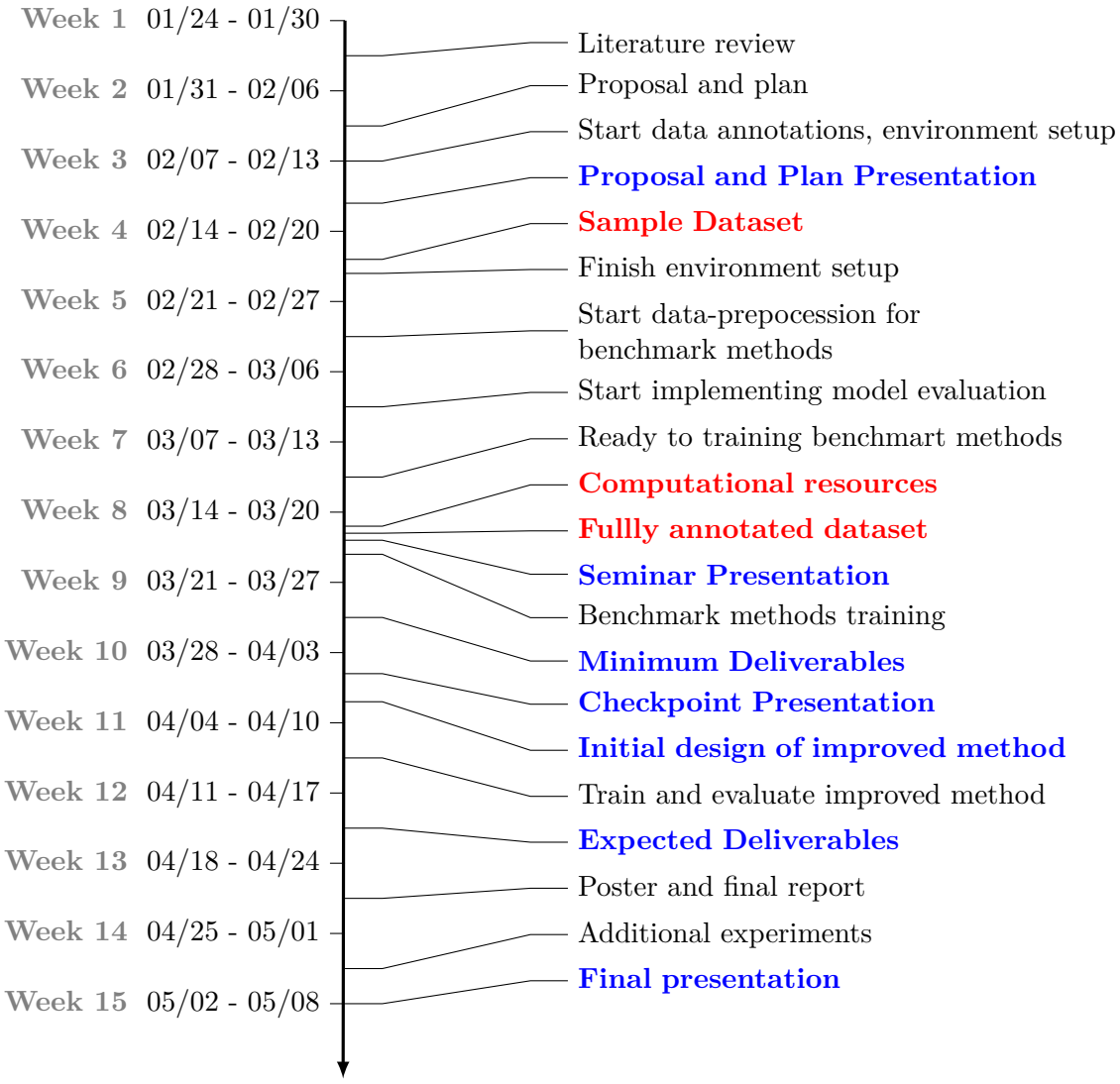

Figure 1: Project timeline, Milestones labeled in blue, Deliverables deadline labeled in red

7 List of dependencies & plan for resolving

1. Dataset & Annotations
   (a) Dataset: Cortical mastoidectomy video dataset provided by JHMI → Need to talk to Dr. Danielle Trakimas to obtain videos.
   (b) Annotation: Phase definition and annotation protocol → Need to talk to Dr. Danielle Trakimas to finalize the annotation protocol and start annotations.
2. Computer, GPU, and server setup
   (a) Computer: Our personal computers with the required packages installed
      i. Environment: Pytorch+torchvision+cuda
      ii. Internet connection to remotely access GPU server.
   (b) GPU resource: ARCADE Lab
      i. ARCADE Lab access → Need to apply and obtain lab access approval from Prof. Mathias Unberath.
      ii. Remote server → Need to set up the remote GPU server service on the ARCADE Lab.
3. Existing Framework & Public dataset
   (a) Existing Framework: Open source frameworks are available online from Paperwithcode and Github
      i. EndoNet: Not available online but should be able to be reproduced.
      ii. MTRCNet-CL: `https://github.com/YuemingJin/MTRCNet-CL`
      iii. Trans-SVNet: `https://github.com/xjgaocs/Trans-SVNet`
   (b) Public dataset:
      i. Cholec80 → Need to apply to CAMMA for dataset access. (`http://camma.u-strasbg.fr/datasets`)
      ii. M2CAI 2016 Challenge Datasets → Need to apply to CAMMA for dataset access. (`http://camma.u-strasbg.fr/datasets`)
4. Clinical advice
   (a) operation analysis
   (b) experiment result analysis

   Need to obtain advice from Dr. Danielle Trakimas.

8 Management Plan

Xucheng

Reading List

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